



Cabinet Office

**The Rt Hon Greg Clark MP**  
Minister for Universities,  
Science and Cities



Department  
for Business  
Innovation & Skills

1 Victoria Street  
London  
SW1H 0ET

Professor David Lane  
Earl Mountbatten Building  
Heriot-Watt University  
Edinburgh  
EH4 4AS

Professor Rob Buckingham  
Culham Centre for Fusion Energy  
Abingdon  
Oxfordshire  
OX14 3DB

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Dear Professors Buckingham and Lane,

## **RESPONSE TO THE ROBOTICS AND AUTONOMOUS SYSTEMS STRATEGY**

This is an open letter to convey the Government's response to the recommendations of the Robotics and Autonomous Systems (RAS) strategy which you both co-authored and published through the Special Interest Group. The strategy is welcomed and I am most grateful for your efforts and those of the Robotics and Autonomous Systems Special Interest Group for this publication in what represents a combined effort of the academic and industrial community.

This letter addresses the Government's position on each recommendation and highlights recent progress. I trust that this response will be welcomed, not only by you both and the Special Interest Group Steering Group, but also the wider RAS community.

### **Recommendation 1 – Invest further in the 5 RAS strategy strands: coordination, assets, challenges, clusters and skills to build the UK's RAS capability.**

The Government recognises the need to invest in Robotics and Autonomous Systems as one of the Eight Great Technologies. Through building on our existing RAS research and industrial capability we can ensure that future growth and success is enabled across a broad range of core industrial sectors, such as aerospace, nuclear and automotive; in addition to enabling new capabilities in emerging cross-sectorial issues like demanding environments.

It is clear that the UK's research and innovation capability in RAS has grown significantly over the last few years. This is partly in response to strategic interventions across the RAS strands for which I have outlined notable examples below.

**RAS Coordination** benefits from the aforementioned Special Interest Group. As you are aware, this will continue to act as a central point for the wider RAS community during the implementation of this strategy. I am pleased to note the progress of this group, growing from less than a hundred members in its first few months to over 870 members today. But this is only a fraction of the community, and through continued engagement and enthusiasm of the Special Interest Group, I am certain that the membership will mature further and generate new connections within the community.

**RAS Assets** have been maximised to develop one of the most capable unmanned aircraft systems (UAS) test and evaluation facilities in the world. The West Wales UAS Environment at Parc Aberporth provides the UK industry and Government with the infrastructure to support development of UAS. This asset enables the UK to test and integrate remotely piloted aircraft systems into UK and the European aviation space. This is only one of number RAS assets available to the UK which provides the required environment to test new capabilities and innovations.

**RAS Challenges** have recently benefited from a competition into how driverless cars can be integrated into everyday life. An award of £19m, announced in the Autumn Statement, funded by the Departments for Transport and Business, Innovation and Skills, and delivered through Innovate UK is supporting projects worth over £32m. These awards will build on our world-leading science and engineering base. This challenge, aligned with the Automotive Industrial Strategy, will exploit our regulatory competitive advantage and see driverless cars being tested on real roads in four UK towns and cities by teams combining the expertise of innovators, academics, local government, insurance companies and major businesses.

**RAS Clusters** of excellence have been formed through the Defence Growth Partnership initiative. Through this, the Government has invested £4.0 million in the UK Centre for Maritime Intelligent Systems based in Portsmouth. This will bring academics, industry and other specialists together to develop cutting-edge technology for use in autonomous unmanned boats. Similarly, through the Local Enterprise Fund, £4.5 million was awarded to Bristol Robotics Institute of Technology, enabling partnerships and innovative businesses to grow. Building on this, the University of West of England have also benefited from a £4.0 million pilot University Enterprise Zone (UEZ). This particular UEZ, which will focus on Robotics, has leveraged an additional £12.5 million of mainly private investment and will see the university working with local business to further these partnerships even more.

Equally, in 2013, the Government invested £35 million as part of a capital boost for RAS. This package for state of the art equipment has enabled leading labs to lay the foundations towards RAS Clusters.

**RAS Skills** were enhanced with a £20 million Government investment towards four new Centres for Doctoral Training in Robotics and Autonomous systems in 2014. David, as an awardee of one of these centres, you are acutely aware of the importance these will play in training the next generation of skilled engineers. These are a vital element in realising the strategy and will equip students with the skills required to grow both our research base and innovation capability.

These highlights are only a sample of the success and progression of the community. Despite these, I recognise that more needs to be done. Therefore, I am pleased to announce that the EPSRC has awarded a £5.0 million programme grant to the Mobile Robotics Group at the University of Oxford to address the fundamental technical issues which impede the development of mobile robotics technology. EPSRC have also recently launched a UK Network for Robotics and Autonomous Systems, this grant will bring the UK academic community together further enhancing RAS coordination. By building connections between leading groups, this grant will accelerate the up-take of new RAS technologies and underpin current and planned investments by the Research Councils, Innovate UK and associated business partners.

Furthermore, Innovate UK, the Royal Academy of Engineering (RAEng) and EPSRC have highlighted other future and on-going activities which build against the 5 strands. For example:

- Innovate UK and the Ministry of Defence, through the Defence Science and Technology Laboratory (Dstl), are to invest up to £5.0 million in CR&D projects to stimulate the development of marine and maritime autonomous systems. This competition opened during October 2014 and will build and maximise on our maritime strength and existing capital investments.
- In addition to the recent strategic investments in capital equipment and doctoral training, EPSRC currently sponsors a £40 million portfolio of high quality research in RAS and closely related fields. This support will continue for investigator-led and industrially inspired research through EPSRC's existing mechanisms.
- In order to develop the next generation of autonomous vehicles EPSRC have launched a call for 'Towards Autonomy - Smart and Connected Control'. This joint initiative with Jaguar Land Rover will commit up to £10 million for research around the central challenge of moving towards a fully autonomous car
- EPSRC have recently launched an open call for RAS Fellowships and are inviting applications from postdoctoral researched to established academics. These individual personal awards, aimed at the applicant's potential in addition to research excellence, will develop UK leadership and provide space for academics to be creative and drive innovation and growth.

The coordinated development of the strategy's strands will enhance the UK's capability and further accelerate RAS technologies through to market. This is crucial in delivering economic growth and in addressing challenges, such as the ageing population.

**Recommendation 2 – Establish the means for funding agencies to formally work together in execution, so that ideas, people and activity flow readily from basic investigation through early stage demonstration to fully trialled commercial product.**

As the main public funders for RAS, Innovate UK and the Research Councils have a RAS portfolio of over £85 million and as I mentioned earlier, Innovate UK and EPSRC are continuing to work collaboratively in RAS to take the research and industrial community forward together.

The Government recognises that the research and innovation ecosystem is complex. Equally, success across this boundary is core to our future endeavours. This is not a simple partnership; research and innovation require effective and flexible collaboration mechanisms. This is why we have developed a complementary environment between Innovate UK and the Research Councils wherein they are able to freely scope these relationships. Through the appropriate co-identification of the challenges faced in RAS, the strength of this partnership will grow and the economic growth potential of RAS can be realised.

**Recommendation 3 – Establish a RAS Leadership Council to engage with senior leaders across a range of sectors in industry, academia and Government, providing independent advisory oversight of planning and execution of the strategy.**

The Government agrees with this recommendation. We will establish a Leadership Council in Robotics and Autonomous Systems. I have asked officials to implement this recommendation.

**Recommendation 4 – Further develop engagement with the EU, investors and corporate resources in the UK and overseas to fuel the development of the 5 strands.**

The Government recognises the value of diversifying the funding sources to support the development of the RAS stands; private investment in RAS will augment and build on the Government's public investment and further develop our capabilities. The UK has a strong history of securing European funding in Robotics; attracting over €80 million from a total budget of €485 million through the 7th Research Framework Programme.

The Government is already working closely with Horizon 2020 through our European Knowledge and Innovation team to build a strong and vibrant relationship where the interests and priorities of the UK can be appropriately represented.

As you know, RAS features prominently in the Horizon 2020 programme. Building on the specific challenges outlined in the euRobotics Strategic Research Agenda, H2020 will commit up to €700 million during 2015-2020. The community must be ready to take advantage and continue to draw on the support provided by both the National Contact Point system and Knowledge Transfer Network.

Equally, UK Trade and Investment (UKTI) is working to ensure that the UK is promoted overseas to attract further inward investment to develop the five strands. For example, both Innovate UK and UKTI recently led a RAS entrepreneurial mission to the rapidly growing US robotics cluster in San Francisco. This highly successful visit has provided a springboard for engaged UK companies which are exploring opportunities in investment and business. UKTI's focus on RAS is set to strengthen over the coming year as the area gains greater interest.

### **Recommendation 5 – Continue to consult widely on potential Assets and cross sector Grand Challenges.**

The Government recognises the need to identify exploitable assets and to consult widely on the cross sector Grand Challenges. The Driverless Car competition, as highlighted earlier, is one such example and builds on our existing infrastructure assets in cities. This challenge has generated significant activity across academia and industry in addition to capturing the public's imagination.

As I previously mentioned, the newly awarded network grant represents an opportunity for the community to come together in identifying the Grand Challenges. By building these around both tangible and intangible assets, the RAS solutions will grow organically and address the growing society needs of the UK.

Through maximising the new and existing frameworks, I am confident that the RAS community will work together on this recommendation and deliver influential challenges to inspire the current and next generation of innovators and researchers.

### **Recommendation 6 – Continue to develop dialogue with those involved in standards and regulation to develop more detailed thinking.**

The Government acknowledges the importance of dialogue with those involved in standards and regulations. In this area, the British Standards Institution is working with Government and industry to ensure standards are aligned to Government Policy and in particular to the Eight Great Technologies and other emerging technologies. The British Standards Institution has a long established national committee on Robots and robotic devices on which the Special Interest Group has representation.

There are number of early international indicators which demonstrate positive work in this area. For example, the ISO 13482 standard for service robots used for personalised care was developed in response to a forecasted market need. By developing the standard in

advance, end user companies are primed to take advantage of the innovation pipeline and bring technologies with a clear line of sight to market.

The Government is already on the front foot; DfT is reviewing the relevant regulation and legislation to determine a clear and appropriate regime for the testing of autonomous cars in the UK, whilst also ensuring public safety. This review reported in early 2015.

Equally, through the work of the Autonomous Systems Technology Related Airborne Evaluation and Assessment consortia, working in collaboration with Civil Aviation Authority (CAA), the Government is already exploring the options to enable both manned and unmanned aircraft to share the skies. Through this initial work we will ensure that the UK can build on its leading position and enable a significant new market for Remotely Piloted and Autonomous vehicles to develop in the civil domain. I am pleased to note progress is already being made. For example, the CAA's guidance for operations in the UK (CAP 722) has been adopted by many other states across the world – an early success in enabling market realisation.

### **Recommendation 7 – Extend outreach and public engagement activities to continue changing public perceptions and improve understanding of public concerns.**

The Government is supportive of initiatives which will enable and develop public dialogue around RAS. An example of this is the Sciencewise programme, funded by BIS, to support public bodies to commission and use public dialogue to improve the public's ability to engage with complicated scientific issues and use the public's opinion to inform policy. As you are aware, the Sciencewise 'Robotics and Autonomous Systems: What the public thinks' review<sup>1</sup> provides a current overview on the views and values of the Public on RAS and is a cornerstone for future activities.

Public dialogue can also be achieved through the Responsible Innovation framework, which is strongly advocated by both EPSRC and Innovate UK. The principles of this framework support the development of ethically and socially accepted impact from publically funded research. This framework has been used to great success in a number of disciplines, such as synthetic biology, and should be employed to build on this recommendation.

It is clear that the public's curiosity in science is growing and can readily access information about research. They are the ultimate customer of new and emerging technologies and, without their support no technology can fulfil its potential. I therefore recommend that the Special Interest Group continues to engage in public dialogue and further explores the range of public values and concerns, and the social and ethical implications of RAS.

### **Recommendation 8 – Articulate to businesses and investors internationally (e.g. through UKTI) that the UK aims to be the best place to invest in taking RAS technologies to market.**

The Government supports this recommendation. I am pleased to note that the UKTI have an ambitious policy and are already articulating to businesses that the UK as the place to invest for RAS technologies. Through UKTI's Innovation Gateway, the Government is connecting the UK's innovation system to international corporations and global markets as well as potential financial investors.

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<sup>1</sup> <http://www.sciencewise-erc.org.uk/cms/assets/Uploads/Robotics-ReportFINAL02-07-2013.pdf>

As you are both aware, the global market for industrial robotics is currently worth over US\$25bn and is forecast to reach US\$37 billion by 2018, while the market for professional service robots will increase from US\$3.4 billion to US\$17.1 billion by 2016. We are uniquely placed to take advantage of these market opportunities and through the UKTI the Government can ensure that progress is made.


Equally, opportunities of a similar scale exist in other applications of RAS. Within a global market estimated to be worth in the order of £100's billions, causing economic impact worth £trillions, the UK has major potential to focus for both strategic investment and trade across:

- Industrial Robotics – increasing automation and autonomous control;
- Healthcare Robotics – home patient monitoring to micro surgery;
- Intelligent Transport – maintenance to automated control;
- Automated Farming – crop monitoring to automated harvesting.

Using our expertise in these areas, I am confident we can generate economic benefit for the UK. To enable this, the Innovation Gateway is working with BIS sector teams, market and investment specialists and UKTI's global network of over 1000 people based around the world to understand and access these new markets. This work will enable partnerships to flourish and grow alongside strategic research in RAS.

The Government's response to the RAS 2020 strategy represents the commitment towards developing the UK's research and innovation capability in RAS. Through building on these recommendations and consolidating our existing strengths, we will develop a world leading position in RAS. I look forward to hearing of the successes from both the academic and industrial community and to exploring RAS technologies in action as they start to address the challenges of our time.

Yours sincerely

A handwritten signature in black ink that reads "Greg Clark". The signature is written in a cursive style with a large, looped initial "G".

**THE RT HON GREG CLARK MP**